Development of multi-grid type Microstrip Gas Chamber

Kazuki Yano[1], Chika Hagai[1], Hiroyuki Takahashi[1], Masaharu Nakazawa[1], Syunji Kishimoto[2*]
[1]The Univ. of Tokyo, Hongo, Bunkyou-ku, Tokyo 113-8656, Japan
[2]KEK-PF, Tsukuba, Ibaraki 305-0801, Japan

Introduction

A Microstrip Gas Chamber(MSGC) has been introduced by A. Oed[1], however, this detector suffers from discharges due to surface streamers and resulting in poor gas gains. Recently a new patterning approach to this type of detector has been proposed, which utilizes a complicated electrode geometry on the surface of the detector[2]. This new multi-grid type MSGC(M-MSGC) is equipped with intermediate grid electrodes placed between the anode and the cathode. This structure is useful for stabilizing the surface charge and therefore realizes high gain and high count rate capability. This paper describes experimental results of M-MSGC such as high rate capability, long term operation and position resolution.

Experimental Setup and Results

A new M-MSGC plate was fabricated by a photolithography technique at VLSI Design and Education Center of the Univ. of Tokyo. Figure 1 shows a cross sectional picture of this M-MSGC plate. In this design, four additional grid strips were put between the anode and the cathode and adequate voltage was applied to each grids to achieve the most optimum bias condition. The distance between the anode and the cathode was 400um and the effective area of the plate was 30mm × 30mm. The detection gas was Ar70% + CH_4 30% and was flowing continuously. The X-rays were irradiated through a window composed of Be.

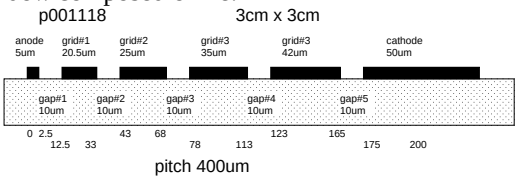

Figure 1: Schematic of M-MSGC

High counting rate capability

Experiments were performed using the BL14A of KEK-PF. The photon beam was collimated to a size of 0.8mmϕ and its energy is 6keV. The detector was operated at the gas gain of 3000. The energy resolution at this gas gain was 14.8%(FWHM). To investigate the gain instability caused by the surface charge effect, the M-MSGC plate was irradiated at the relatively high counting rate of 10kcps/0.8mmϕ beam. In case of conventional MSGCs, the gas gain will be decreased to the half of the initial gain in a few minutes for such a high counting rate. However, the gas gain of M-MSGC was very stable after the gas gain was decreased only 5% in course of first 3 minutes(See Fig.2). This result shows that the additional grid strips were effective to remove surface charge.

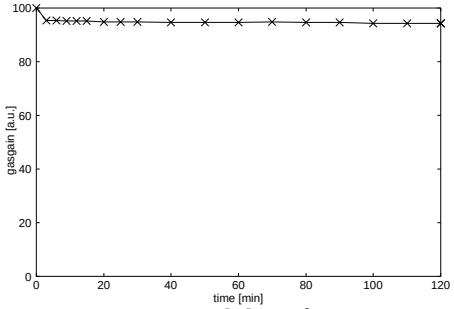

Figure 2: Gain stability of M-MSGC

Position measurement

Using the charge division method, one dimensional position resolution was measured. Signals were read from the right and left side of the anode root line. The photon beam collimated to 20um was scanned vertically to the anode strips. The photon energy was 8keV. Figure 3 shows the results of position detection. The measured position resolution was 0.8mm(FWHM).

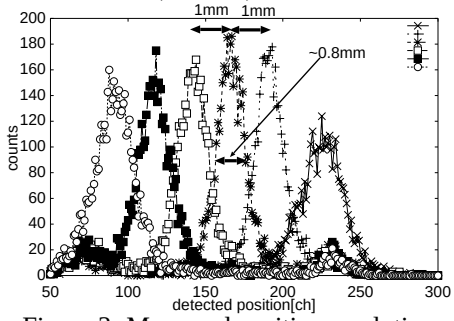

Figure 3: Measured position resolution

Conclusion

To investigate the properties of M-MSGC, some experiments were performed. Compared to the conventional MSGC, the M-MSGC could be operated stably under high counting rate. The position resolution was 0.8mm. This detector is very useful in the field where high gain, good position resolution and the stable operation are required.

References

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*syunji.kishimoto@kek.jp